SSVEO IFA List **Date:02/27/2003**

STS - 41, OV - 103, Discovery (11) **Time:04:19:PM**

Tracking No	Time	Classification	Documentation		Subsystem
MER - 2	**MET:** 000:01:02	Problem	**FIAR**	**IFA** STS-41-V-01	DPS - GPC
DPS-01	**GMT:** 279:12:50		**SPR**	**UA**	**Manager:**
			IPR 39V-0001	**PR**	
					Engineer:

Title: SM2 NBAT had GPC 2 assigned to String 3. (ORB)

Summary: Problem was transferred to Integration per PRCBD S044840A. IFA number was changed to STS-41-I-01.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:17:52	Problem	**FIAR** a) B-FCE-029-	**IFA** STS-41-V-02	CCTV
INCO-01	**GMT:** 280:05:40		F018; b) B-FCE-029-F019	**UA**	**Manager:**
			SPR	**PR**	
			IPR None		**Engineer:**

Title: CLOSE CIRCUIT TELEVISION CAMERA PROBLEMS:a) Camera C Image Burnb) Camera D Incorrect Color Phasing (GFE)

Summary: DISCUSSION: a) At approximately 280:05:40 G.m.t., closed circuit television (CCTV) camera C had an image of the Orbiter structure burned into it. This condition was attributed to the camera being exposed to excessive illumination when focused on the Orbiter structure. Although the image quality was degraded from the burned-in image, camera C was still usable for the remainder of the mission.

b) During the mission, the image from camera D had blinking or flashing colors. This condition was indicative of incorrect color phasing that was attributed to a potentiometer drift which tends to occur as the camera ages. Although the image from the camera was degraded, the camera was still usable throughout the mission. CONCLUSION: a) The camera C burned in image was caused by an overexposure to intense light. b) The incorrect color phasing on camera D was most likely caused by potentiometer drift. CORRECTIVE_ACTION: Both CCTV cameras were removed from the vehicle and returned to the vendor. The silicon intensifier tube in camera C is being replaced which will correct the burned-in image condition. Analysis is being performed on camera D to determine the exact cause of the incorrect color phasing.

Corrective action will be performed as dictated by the results of the analysis. During the Level II PRCB baseline of this inflight anomaly, an action was given to cease bringing minor CCTV problems of this nature to Level II after STS-41. Agreement has been reached with Level II that these problems will continue to be listed on the MER Problem Tracking List to facilitate corrective action. However, Level II will not pick up minor CCTV problems on their inflight anomaly list, thereby eliminating need for Level II closure. CCTV problems that impact the mission will continue to be resolved using normal inflight anomaly-reporting procedures. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 003:00:22	Problem	**FIAR**	**IFA** STS-41-V-03	APU
MMACS-02	**GMT:** 282:12:10		**SPR** 41RF01	**UA**	**Manager:**
			IPR	**PR** APU-3-12-0252	
					Engineer:

Title: APU 1 Fuel Pump Heater System B Fail On (ORB)

Summary: DISCUSSION: During the normal on-orbit APU heater reconfiguration at 282:12:10 G.m.t., the auxiliary power unit (APU) 1 fuel pump/gas generator valve module (FP/GGVM) heater system was switched from A to B system. The APU 1 fuel bypass line temperature (V46T0128A) immediately began rising at an unusually high rate (37? F per minute versus the normal 6? F per minute). In four minutes the bypass line temperature rose from 110? F to 258? F, generating a caution and warning alarm at 180? F. The normal heater cutoff temperature is approximately 130? F. The crew switched from the B to the A system heaters which operated nominally for the remainder of the flight.

Failure analysis at KSC revealed that the failure was due to a short-to-ground condition in the B heater circuit between the second and third heaters of a four-heater string. The heater lead wire was pinched under a wire-bundle clamp that had been removed and reinstalled during the preflight replacement of the heater system A thermostat because of a sudden change in controlling set points during the prior OV-103 mission (IFA STS-31-11). The pinched condition removed a portion of the heater lead wire clamp. The APU FP/GGVM heater circuit is unique among Orbiter heater circuits in that it is controlled from the ground end rather than the power end. This means that a "smart" short to ground (such as occurred here) disables the thermostat from controlling the heater. Because the short was located after the second heater of the string of four, the first two heaters received a higher current flow, causing temperatures to increase at the abnormally high rate. The last check-out of the B heater circuit had occurred via OMRSD File IX on-orbit functional verification during the previous mission (STS-31). Following the A thermostat replacement during ground turnaround operations, the A heater system was checked out by verifying a temperature increase per the OMRSD File III, Volume 46 requirement. However, this requirement did not specify that the B system be functionally verified since it was not disturbed. CONCLUSION: The APU 1 fuel heater B failed on because of a short-to-ground condition in the heater lead wire between the second and third heaters of a four-heater string. The short was caused by the heater wire being pinched in a wire-bundle clamp, causing a portion of the insulation to be removed, thereby exposing a bare wire to the metallic portion of the grounded clamp. This short-to-ground caused excessive current through the first two heaters in the string which resulted in a high temperature rise rate. CORRECTIVE_ACTION: For the short term, a requirement to check both A and B heater system operations during ground turnaround operations, in addition to the on-orbit check-out, is being implemented. A long-term fix to the circuit that would change heater

control from the ground end to the power end is being defined. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 002:08:48	Problem	**FIAR**	**IFA** STS-41-V-04	IMU
GNC-01	**GMT:** 281:20:36		**SPR** 41RF02	**UA**	**Manager:**
			IPR 39V-0004	**PR** GNC-3-12-0105	
					Engineer:

Title: Inertial Measurement Unit 1 Failed by Redundancy Management (ORB)

Summary: DISCUSSION: At 282:20:35 G.m.t., inertial measurement unit (IMU) 1 (serial number 007) exhibited a Z-axis accelerometer channel failure. The first indication of the failure was for a period of approximately 6 minutes, during which time there was a lost of 40 feet/second in velocity. Redundancy management (RM) failed the IMU at 282:20:36:57, nearly 2 minutes after the start of the loss. Through the remaining on-orbit period, the acceleration continued to be erratic with periods of good performance and bad performance. One occurrence at 282:22:47 indicated an acceleration reversal while the other occurrences indicated only reduced acceleration. There were no other indications of anomalous performance. The IMU was left deselected but in the OPERATE mode. Loss of 1 IMU necessitates a minimum duration flight (MDF). This failure occurred within the MDF timeline requirement. During re-entry the performance was acceptable throughout the entry and landing. Serial number 007 exhibited the same failure during postlanding testing at KSC.

CONCLUSION: Troubleshooting performed by the vendor has isolated the failure to be internal to the platform. Further troubleshooting of this IMU will continue. The exact cause is currently unknown but is considered a non-generic problem. CORRECTIVE_ACTION: A spare IMU (serial number 10) has been installed on OV-103. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. Inflight IMU failures are handled via RM or manual deselection and monitored for possible reselection as was performed on STS-41. Had the failure occurred during prelaunch operations, the Launch Commit Criteria (LCC) requires 3 operational IMU's to remain two-fault tolerant (Reference GNC-60 IMU Failure Indication LCC).

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:00:08	Problem	**FIAR**	**IFA** STS-41-V-05	ECLSS, BFS
EECOM-04	**GMT:** 279:11:56		**SPR** None	**UA**	**Manager:**
			IPR None.	**PR**	
					Engineer:

Title: BFS Backup dP/dT Calculation Triggered Fault Message after MECO. (ORB)

Summary: DISCUSSION: Approximately 22 seconds after main engine cutoff (MECO), a "B/U dP/dT" alarm was triggered by the backup flight software (BFS). This

alarm was driven by a rate-of-change in cabin pressure computation in which the BFS calculates the change in cabin pressure over a 30-second interval and updates the computation output every 5 seconds. The computation exceeded a -0.15 psi/min and the alarm triggered at -0.12 psi/min. The hardware dP/dT sensor registered and expected, slightly negative change in cabin pressure at this time because of normal expansion of the cabin resulting from the cessation of acceleration at MECO. However, the rates registered by the hardware dP/dT sensor did not verify the large rate annunciated by the backup calculation. Since the hardware sensor indicated expected rates, the backup alarm did not impact crew safety or mission success.

This mission was the first flight of the new cabin pressure sensor. However, the presence of the new sensor is not thought to have been a significant factor in the negative dP/dT calculation since a similar event that almost triggered the alarm was experienced on STS-35, which still used the old model cabin pressure sensor. CONCLUSION: Analysis showed that the onboard rate calculation was close to a one data-bit drop (0.04 psi per bit) just prior to MECO. The normal cabin expansion after MECO caused a pressure drop slightly larger than one bit. This caused the calculation to interpret the pressure drop as a two data-bit drop, which was sufficient to trigger the alarm. This two-bit change was a random, near worst case reaction of the calculation to the normal cabin expansion at MECO. CORRECTIVE_ACTION: None. Fly as-is. This was the only occurrence of a two data-bit drop in the BFS dP/dT calculation in the 38 Shuttle missions to date. Consideration was given to changing the BFS algorithm to screen out these random occurrences; however, the current algorithm was found to be the most effective calculation. Consideration was also given to changing the alarm limit from -0.12 to -0.15 psi/min which would effectively screen the majority of these random occurrences. However, changing the limit also incurs the risk of delaying the warning for a real cabin leak on ascent, which was deemed more important than eliminating these random nuisance message. If this message recurs after MECO, the hardware dP/dT sensor will verify if the message is annunciating a nuisance alarm. EFFECTS_ON_SUBSEQUENT_MISSIONS: Possible "B/U dP/dT" nuisance alarm after MECO.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 003:23:28	Problem	**FIAR**	**IFA** STS-41-V-06	D&C
GNC-02	**GMT:** 283:11:16		**SPR** 41RF03	**UA**	**Manager:**
			IPR 39V-0005	**PR**	
					Engineer:

Title: The ADI RATE Select Switch on Panel F6 Indicated HIGH and MEDIUM Simultaneously. (ORB)

Summary: DISCUSSION: At 283:11:16:33 G.m.t., while the CDR's ADI-RATE select switch was in the MEDIUM position, telemetry indicated the presence of a HIGH discrete in addition to the MEDIUM discrete.

The crew received a "DISPLAY SW L" fault message. Approximately 26 seconds later, the HIGH discrete returned to normal. The crew was not using the switch at the time of the occurrence, and the anomaly did not recur for the remainder of the mission. Postflight troubleshooting on the vehicle at KSC failed to reproduce the anomaly. The switch was, however, removed and replaced because this failure mode could be indicative of internal contamination. Subsequent X-rays and teardown revealed a solder particle of sufficient size to cause either a contact-to-contact or a contact-to-ground short circuit. This switch had been in OV-103 since initial delivery. CONCLUSION: This anomaly was caused by internal particle (solder ball) contamination. CORRECTIVE_ACTION: The switch has been removed and replaced. Final corrective action is pending completion of failure analysis and will be documented on CAR 41RF03-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Postlanding	Problem	**FIAR**	**IFA** STS-41-V-07	MECH
None	**GMT:** Postlanding		**SPR** 36RF08	**UA**	**Manager:**
			IPR	**PR** PYR-3-12-0153	
					Engineer:

Title: The debris plunger in the (EO-2) fail to Seat/Ordnance pieces found on runway. (ORB)

Summary: DISCUSSION: The postflight inspection at Dryden Flight Research Center, revealed that the debris plunger in the EO-2 (LH2) separation fitting debris container was caught by the frangible nut halves and failed to seat properly. Three pieces of spent ordnance assembly were found on the runway beneath the LH2 ET/Orbiter umbilical opening. In addition, a two-inch long piece was found on the runway beneath the LO2/ET/Orbiter umbilical opening. This same type of anomaly occurred on STS-29 and STS-34, and both were closed with similar rationale.

CONCLUSION: The LH2 (EO-2) separation hole plugger was prevented from seating by the debris which lodged in its path during separation. The hole plugger partially accomplished its purpose by preventing the majority of the debris from escaping into the umbilical cavity. CORRECTIVE_ACTION: Fly-as-is based on the following rationale: The interference with the hole plugger is a random event depending on debris rebound velocity attenuation and direction. The probability of a fragment preventing ET-door closure is considered highly remote. The vehicle is moving away from any escaping debris during the ET separation phase. Any escaped debris must abruptly change direction perpendicular to the original trajectory and then make its way to the clevis/rod to create a jam. A proposed design modification to improve Orbiter/ET separation debris containment is under review for 1992 implementation. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 003:23:56	Problem	**FIAR**	**IFA** STS-41-V-08	D&C
GNC-03	**GMT:** 283:11:44		**SPR** 41RF05	**UA**	**Manager:**
			IPR 39V-0009	**PR**	
					Engineer:

Title: The Left Rotational Hand Controller (RHC) Trim Enable/Inhibit Switch Experienced a Contact Miscompare. (ORB)

Summary: DISCUSSION: At 283:11:44:12 G.m.t., a Trim Inhibit Fail indication was received on the ground, indicating a miscompare between the A and B contacts on the left (CDR's) TRIM RHC/PNL ENABLE switch (Panel F3 Switch S2). The switch was in the INHIBIT position (contacts closed) at the time of the anomaly. Data analysis indicates that V72K1160X (LH RHC TRIM INHIBIT A) went from "1" to "0" at this time while V72K1161X (LH RHC TRIM INHIBIT B) remained at "1". After approximately 16 seconds the A measurement returned to "1". This would imply that the A contact experienced an open condition during this 16 second period. The crew was then requested to cycle the switch from INHIBIT to ENABLE and back to INHIBIT. Telemetry data indicate that both sets of contacts followed the switch commands during this test. The switch then remained in the INHIBIT (which is the desired position) for the remainder of the mission and no further anomalies occurred.

This switch provides discrete inputs to MDM FF1 (CONTACT A) and to MDM FF2 (CONTACT B) for use by flight control software. If both INHIBIT discretes are present, the flight control system will not acknowledge trim commands from either the CDR's RHC or from the trim switches on panel C3. The RM default for this switch is the ENABLE position. The onboard Fault Detection and Annunciation (FDA) does not annunciate this failure to the crew. Ground monitoring is required to detect an anomaly. The prime purpose of this switch is to inhibit trim signals in the event of failures which would result in "runaway" trim commands. The back-up for this function would be to turn off the PANEL TRIM switch on panel F3 and/or turn off the FLT CNTLR POWER on panel F7. This type switch is subject to the "teasing" phenomena which could account for the symptom; however, the flight crew stated that teasing or inadvertent actuation did not occur. No other anomalies were noted on the associated MDM FF1 card. Postflight troubleshooting at KSC consisted of wiggle and pull tests on the associated wiring and connector, inspection of wiring, demate and inspection of the connector, and power-on monitoring for recurrence. The anomaly did not recur and could not be reproduced. CONCLUSION: The cause of this anomaly is unknown. The most likely cause was either inadvertent teasing of an intermittent nonreproducable open circuit in the switch path between control bus AB1 and MDM FF1. CORRECTIVE_ACTION: No corrective action is required unless the anomaly recurs. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Postlanding	Problem	**FIAR**	**IFA** STS-41-V-09	Active Thermal Control
EECOM-05	**GMT:** Postlanding		**SPR** 41RF06	**UA**	Subsytem
			IPR 39V-0018	**PR**	**Manager:**
					Engineer:

Title: Ammonia Boiler Primary A Controller Controlled to 31.6 Degrees Flash Evaporator Outlet Temperature (ORB)

Summary: DISCUSSION: At approximately 283:14:14 G.m.t., during postlanding operation of the ammonia boiler, the system A primary controller controlled to a flash evaporator outlet freon temperature of 31.6? F. This was outside the specification range of 35 ? 3? F. Freon temperatures below 32? F can pose the risk of freezing the

water loops. However, in this case the freon temperature at the freon/water loop interchanger remained above 35? F, so freezing was not a concern and no contingency action was taken.

Postflight, both flash evaporator outlet temperature sensors were checked at ambient temperature and were found to be within specification but biased low by approximately 0.5? F. Therefore, the 31.6? readings for these sensors actually reflected freon temperatures slightly above 32?. When the ammonia boiler assembly was removed and replaced because of an existing leak, the primary A controller ammonia boiler outlet temperature sensor was found to be approximately 25 percent debonded. This temperature sensor actually controlled the operation of the ammonia boiler and its output is not monitored during the mission. Because of the debonded condition, this temperature sensor was influenced by ambient temperatures that were warmer than the freon and drove the ammonia controller to cool the freon to 32? F. CONCLUSION: The evaporator outlet temperature readings of 31.6? F were caused by a combination of a bias in the flash evaporator outlet temperature sensors and a partial debonding of the ammonia boiler outlet temperature sensor for the primary A controller. This condition did not post any hazard to the crew or Orbiter. CORRECTIVE_ACTION: The ammonia boiler assembly was removed and replaced for an existing leak. The replaced boiler assembly was tested and controlled to approximately 35?, the middle of the specified range. The flash evaporator outlet temperature sensors were within specification and will be flown as-is. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 004:01:26	Problem	**FIAR**	**IFA** STS-41-V-10	HYD
None	**GMT:** 283:13:14		**SPR** 41RF07	**UA**	**Manager:**
			IPR	**PR** HYD-3-12-0426	
					Engineer:

Title: Hydraulic System 2 Priority Valve Pressure Lag (ORB)

Summary: DISCUSSION: When the hydraulic system 2 main pump pressure switch was put to the "Normal" position during entry operations at 283:13:14:09.8 G.m.t., the bootstrap accumulator pressure lagged the main pump pressure by 5.8 seconds before instantaneously rising to an equal pressure. No lag should have occurred in the equalization of these pressures. After pressure equalization, the system performed nominally for the remainder of auxiliary power unit operation.

Flight data indicated that the hydraulic system 2 accumulator pressure and reservoir pressure tracked each other during the period before and after the lagging occurred, which implies that a check valve internal to the priority valve was sluggish to open. Two such lags of longer duration were experienced by another priority valve on hydraulic system 2 on OV-104 during STS-27 (IFA STS-27-14). Examination of that priority valve after STS-27 revealed contamination and scoring within the priority valve to be the cause of the lags. CONCLUSION: The delay in hydraulic system 2 accumulator pressure matching the associated main pump pressure was most probably the result of a restriction in the movement of the check valve internal to the priority valve. CORRECTIVE_ACTION: The hydraulic system 2 priority valve was removed and replaced. A failure analysis will be performed to determine the cause of the problem. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 1	MET:	Problem	FIAR	IFA STS-41-V-11	APU
None	GMT:		SPR 41RF08	UA	Manager:
			IPR	PR APU-3-12-0254; APU-3-12-0253	Engineer:

Title: A) APU 2 Heater 2A Set Point Drifting, B) APU 3 Heater 3A Set Point Drifting (ORB)

Summary: This problem was deleted per PRCBD S448406 direction.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET: Postlanding	Problem	FIAR	IFA STS-41-V-12	TCS
None	GMT: Postlanding		SPR 41RF09	UA	Manager:
			IPR	PR STR3-12-3648, STR3-12-3491	Engineer:

Title: Lost Upper Joint of Aft Payload Bay Door Environmental Seal (Xo 1307 Bulkhead) (ORB)

Summary: DISCUSSION: Postflight inspections revealed that the upper seal joint of the aft payload bay door (PLBD) environmental seal (Xo 1307 bulkhead) was missing. The joint seal was recovered from the payload bay (behind the TCS blankets) during the postflight inspections of the area.

Postflight photographic analysis of on-orbit Xo 1307 bulkhead TCS blanket photographs revealed that the joint seal was missing. The joint seal had been removed and reinstalled prior to the STS-41 mission. CONCLUSION: 1. Paper search and hardware inspection of similar seals indicated improper installation. Joint seal inspections showed areas of exposed attachment substrate (not bonded) in violation of the installation drawing. 2. Material evaluation of the seal in question revealed expired surface etching, which is required for proper adhesion. This seal was removed (prior to STS-41) due to debond condition and an attempt at reinstallation was made in violation of the bonding surface preparation specification. 3. This problem is general throughout the fleet as well as the available spares since the surface etching was performed at manufacturing and expires 6 months after manufacturing. Seals with expired surface etching have been installed in all the vehicles in the fleet. 4. A potential PLBD interference while the vehicle is in the vertical positions is also being considered, due to the finding of interference markings in the fitting above this location 5. No system installation verification specifications are in place for the inspection and functional verification of this hardware (e.g. visual, bond verification, pull tests, compression checks, leak checks, interval functional verification (OMRSD), etc.). 6. A disparity in managing organizations exists. Design centers (JSC and Rockwell-Downey) manage this hardware under the thermal protection system design group. Orbiter processing at KSC handles the same hardware under the structure group. This dissimilarity adds complexity to the maintenance of the hardware. The probability of mistake is greater, as it requires the maintenance and research of several specification

documents to perform the installation of this hardware. No verification is attempted after installation since there is no requirement. This complexity is demonstrated by the current hardware problem experience. CORRECTIVE_ACTION: CORRECTIVE ACTIONS - OV-103 FLIGHT 12 (STS-39): 1. Manufacture new joint seal with new surface etching and assure an installation in accordance with the drawing. Action completed per PR #STR-3-12-3491, 1-17-91. 2. Perform an inspection of all the remaining joint seals and document all discrepancies for Material Review Board disposition. Action completed per TPS #492, PR #STR3-12-3648, 3649, 1-22-91. 3. Material Review Board dispositioned all seals acceptable for flight. 4. Perform an inspection of this area while the vehicle is in the vertical position with door cycles performed for potential door interference investigation. For information only. No constraint to STS-39. Generic Actions - Near Term: ---------- 1. Initiate logistic problem report to purge all stock of joint seals with expired surface etching. Action: VF5/H. Kolkhorst 2. Initiate an Engineering Order to add surface preparation instructions to the installation drawing. Action: ES3/C. Ortiz. 3. Generate the test preparation sheet to initiate an inspection of joint seals on the remaining vehicles. Record discrepancies for Material Review Board (MRB) disposition. Action: Submit Chit. VF3/D. Corcoran Generic Actions - Longterm: ---------- 1. Clarify installation specifications. Only seals with new surfaces preparation can be installed. Action: ES3/C. Ortiz. Submit to TSR/CCB. 2. System verification is required after an installation. Interval system functional verification (OMRSD) is also required. The requirements for the verification must be generated. Action: ES3/C. Ortiz/submit RCN. 3. The hardware is to be maintained under the Orbiter thermal protection system standard maintenance and material review maintenance procedures. These specifications are compiled into one document which eliminates the complexity and reduces the probability of mistake. The TPS specifications are regularly maintained through the TPS specification change description (TSCD) procedure for prompt and efficient hardware maintenance. Action: ES3/C. Ortiz/submit change to TSR/CCB. EFFECTS_ON_SUBSEQUENT_MISSIONS: There is no effect on OV-103/STS-39. Inspections have revealed all discrepant hardware and appropriate dispositions have been performed. OV-102 and OV-104 are being inspected and the results will be evaluated.